Proceedings of the United States National Museum

SMITHSONIAN INSTITUTION • WASHINGTON, D.C.

Volume 121 1967 Number 3631

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SMITHSONIAN INSTITUTION PRESS

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Status of Genera *Branchiobdella* and *Stephanodrilus* in North America with Description of a New Genus (Clitellata: Branchiobdellida) [1]

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In a previous paper (Holt, 1960), the status of one North American species of the branchiobdellid worms that had been assigned by an earlier worker to a non-American genus was clarified. An attempt is made here to establish the generic affinities of the remaining North American branchiobdellids that have been placed in Asiatic or European genera. There are three of these: *Branchiobdella tetradonta* Pierantoni, 1906; *Branchiobdellida americana* Pierantoni, 1912; *Stephanodrilus obscurus* Goodnight, 1940. Since one of the areas of intrinsic interest in the study of the branchiobdellids is a consideration of their zoogeography, it is important to determine if these species are assigned correctly and, hence, if there are defensible cases of multicontinental generic ranges among them.

A brief reference has been made to this problem before and attention has been directed to the general relationships of the branchiobdellid fauna of North America to those of Asia and Europe (Holt, 1964). It is not beyond credibility that representatives of the same genus might occur in eastern Asia and in eastern North America as is reputed to be the case for one of the species I am considering herein: my studies

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indicate that this does not occur and that the distributional patterns of the branchiobdellids do not conform to those of their astacid hosts.

The origin of the taxonomic problems I am involved with go back to the early days when the casual students of the branchiobdellids held such broad generic concepts that there was a tendency to assign any species not quite obviously distinguished by peculiarities of body form and ornamentation to the European genus *Branchiobdella*. Pierantoni (1912, p. 8), in the first monograph of the order, listed five genera, mostly separated by such characters of body form, though he was aware of the distinctive difference (one testicular segment as opposed to two) between the genus *Branchiobdella* and the other genera. In addition, he and perhaps others worked with material recovered from the bottoms of museum jars in which crayfish collections were stored. Such material almost invariably is in such a poor state of preservation that specific diagnoses or even generic assignments are difficult, doubtful, and often futile.

Moore (1894) in his work on branchiobdellids during the time when many workers considered them leeches placed Leidy's species *Astacobdella philadelphica* (Leidy, 1851) in the European genus *Branchiobdella* and described as new members of this genus *B. illuminata*, *B. pulcherrima*, and *B. instabilia*. He quickly reassigned *B. illuminata*, establishing the new genus *Bdellodrilus* for it in his excellent treatment of its anatomy (Moore, 1895). Pierantoni (1912, pp. 21–22), who realized that these species have two testicular segments, placed *Branchiobdella pulcherrima* and *B. instabilia* in Moore's genus *Bdellodrilus*. It remained for Ellis (1919, pp. 243–253) to establish the genera *Xironogiton*, in which he placed *Bdellodrilus instabilia*, and *Xironodrilus*, which includes *B. pulcherrima*. Ellis, however, did not have material that would allow him to deal with *Branchiobdella tetradonta* (Pierantoni, 1906, p. 3) and *B. americana* (Pierantoni, 1912, p. 14). The next important paper in which these species were considered was written by Clarence J. Goodnight (1940), who retained Pierantoni's generic assignments for them. Though he had not seen anything he could identify as *B. tetradonta*, he did consider animals from Cleveland, N.Y., taken from *Cambarus bartonii robustus* (Goodnight, 1940, pp. 28–29) as representative of *B. americana*. In the same paper (p. 55) he described the third species I am dealing with here as *Stephanodrilus obscurus*. *Stephanodrilus* is a junior synonym of *Cirrodrilus* Pierantoni (Yamaguchi, 1934, pp. 191–192), and Yamaguchi's error in ignoring the law of priority by using *Stephanodrilus* as the name of the Asiatic species, all of which he considered to be congeneric, was corrected by Goodnight (1940, pp. 55, 63) by reverting to the use of both of the Pierantonian names (*Cirrodrilus* and *Stephanodrilus*). For the present, basing the position on Yamaguchi's descriptions, figures, and some Japanese material that he very kindly gave me a few years ago, I accept his decision

as to the generic unity of his Japanese worms. The correct name of the genus, then, must be *Cirrodrilus* Pierantoni, 1905, and not *Stephanodrilus* Pierantoni, 1906. If Goodnight was correct in placing his species from Fall River, Calif., in the Asiatic genus, its name must become *Cirrodrilus obscurus* (Goodnight). One of the conclusions of the present paper, however, is that he was not correct and that *S. obscurus* must become the type of a new genus.

Magmatodrilus, new genus [3]

Stephanodrilus.—Goodnight, 1940, p. 55. [In part.]

TYPE-SPECIES.—*Magmatodrilus obscurus* (Goodnight, 1940), here designated by monotypy.

DIAGNOSIS.—Medium sized, stout branchiobdellid worms with two pairs of testes; unpaired nephridiopore on the dorsum of segment III; body terete; spermiducal gland with vasa deferentia entering entally; prostate absent; ejaculatory duct present; bursa large, enclosing protrusible penis entally; spermatheca present, not bifid, with ectal duct and bulb invested with thick muscular covering.

DISTRIBUTION AND AFFINITIES.—*Magmatodrilus* at this time stands as a monotypic genus known only from the type-locality of *M. obscurus*.

Goodnight's (1940, p. 55) assignment of *S. obscurus* to *Stephanodrilus* (=*Cirrodrilus*) appears to rest upon the absence of a prostate and a mistaken belief that the anterior nephridia open by separate pores on the dorsum of segment III. In addition to *Cirrodrilus*, the genera *Xironodrilus*, *Xironogiton*, *Ankyrodrilus*, and *Branchiobdella* have paired nephridiopores, lack a prostate and, with the exception of *Xironodrilus*, the vasa deferentia enter the spermiducal gland along its midlength rather than entally. Most genera that have a common anterior nephridiopore also have a prostate gland. The closest relatives of *Magmatodrilus*, then, should be among those genera in which a prostate is absent and the anterior nephridia open by a common pore on the dorsum of segment III. There are three (possibly four) such genera, including an unnamed one represented by species from the southeastern United States and Mexico: *Bdellodrilus*, *Caridinophila*, and the Mexican genus. The prostate of *Ceratodrilus* (the fourth possible relative of *Magmatodrilus*) is a minute lobe or region of differentiated epithelial cells on the side of the spermiducal gland (Holt, 1960, pp. 57, 63). Leaving this question for the moment, *Bdellodrilus illuminatus* (the genus is monotypic) differs from *Magmatodrilus* in the possession of an eversible penis, in the entrance of the vasa deferentia along the midlength of the

[3] From *magma* (Greek, =lava) + *drilos* (Greek, =worm), masculine, "lava-worm" for the locality, springs in the lava beds of Shasta County, Calif., from which topotypes were taken.

spermiducal gland, and in the primitive bifid character of the spermatheca. *Caridinophila unidens* (another monotypic genus) from Yunnan Province, China, lacks a spermatheca, has a peculiar almost spherical spermiducal gland (Liang, 1963, pp. 564, 569), and cannot be considered in any way close to *Magmatodrilus*. The unnamed group of species from Mexico, Georgia, and South Carolina resembles *Magmatodrilus* in the absence of a prostate, in the entrance of the vasa deferentia at the ental end of the spermiducal gland, and in the large size of the copulatory bursa, but differs in the facies (size and shape) of the jaws and most importantly in the presence of an eversible penis instead of the protrusible one of *M. obscurus*. The latter point requires further comment: the penes of *Bdellodrilus illuminatus*, *Ceratodrilus*, *Oedipodrilus*, *Branchiobdella*, and perhaps those of *Cirrodrilus* and *Ankyrodrilus* are eversible, i.e., the penis itself is turned inside out in copulation; those of other genera are protrusible, i.e., the bursal atrium everts and carries to the outside a cone-shaped muscular penis papilla that does not itself evert. Material in museum collections, however, rarely contains animals with everted or protruded penes, and conclusions as to the functioning of the organ frequently, as in the case of *Magmatodrilus*, rest on inferences from the structure of the uneverted or unprotruded penis. In brief, *Magmatodrilus* also is related to *Ceratodrilus* but differs in the lack of body ornamentation (peristomial and body tentacles or projections), in the presence of a rudimentary or vestigial prostate in *Ceratodrilus*, and in the presence of a protrusible instead of an eversible penis in *Magmatodrilus*. Further study may unite the species of the unnamed southeastern genus with *Magmatodrilus*, but following the criteria previously used (e.g., Holt, 1953, 1960, 1965; Hoffman, 1963; Liang, 1963), *Magmatodrilus* must be considered a separate genus.

Magmatodrilus obscurus (Goodnight)

FIGURES 1–4

Stephanodrilus obscurus Goodnight, 1940, p. 55.

DIAGNOSIS.—Jaws subrectangular in en face view, dental formula 6/5; prosomites of segments I–IV, VIII raised (supernumerary muscles present); spermiducal gland with large anterior deferent lobe, shorter posterior one, gland long and looped at ental end of bursa; bursa large, extending to dorsal margin of segment VI; spermathecal bulb clavate or bulbose, without ental process, wrinkled and often appearing in sections to be diverticulate. Average size of 10 measured animals 2.8 mm in length.

TYPE-LOCALITY.—Fall River, Shasta County, Calif. (Goodnight, 1940, p. 55). Additional topotypical material: Thousand Springs

(head of Fall River) on Thousand Springs Ranch,[4] Fall River Mills, Shasta County, Calif.; collectors, Perry C. and Virgie F. Holt.

DISPOSITION OF MATERIAL.—Holotype, USNM 20568; 2 topotypes, USNM 45696; 11 topotypes, PCH 1818, in my collection at the Virginia Polytechnic Institute.

Cambarincola philadelphica (Leidy)

Cambarincola philadelphica (Leidy), 1851, p. 209.
Branchiobdella americana Pierantoni, 1912, p. 14.—Hall, 1914, p. 190.—Goodnight, 1940, pp. 28–29.

Pierantoni (1912, p. 14) described *Branchiobdella americana* on the basis of material in the possession of the Hamburg Museum. In the summer of 1966, Professor Richard L. Hoffman of Radford College visited the Zoologische Staatsinstitut und Zoologische Museum at Hamburg and inquired as to the existence of this material. Through Dr. Hoffman's good offices, Dr. M. Dzwillo lent me this material, consisting of the syntypes. I am grateful to both of these scholars. The material itself, upon which Pierantoni based his diagnosis of *B. americana*, is macerated badly and must have been so when he examined the material and described *B. americana* as follows:

> Prostomio intero, poco slargato a ventosa, capo ben distinto dal corpo; corocina di papille circumboccali presente; superficie ventrale del corpo non appiatta, corpo non rigonfio nella regione mediana, quasi cilindrico.
>
> Ventosa terminale poco prominente.
>
> Clitello poco visibile.
>
> Lunghezza mm. 5 circa.
>
> Mascella disugali; la dorsale (Fig. 6B nel testo e 7A della tavola) provveduta di un grosso dente mediano e di due paia di dentelli laterali rivolti in basso; la ventrale di due grossi denti (Fig. 6C nel testo e 7B della tavola) con mediani alquanto divaricati e sol paio di dentelli laterali. Questo due mascelle nella disposizione dei denti si corrispondo in modo che i dente della mascelle ventrale ingranano negli spazii che intercedo fra i denti e dentelli consecutivi nella dorsale, il che avviene di frequente nella specie a mascelle disuguali.
>
> La spermateca in questa specie non è molto sviluppata e si presente in forma di ampolla o fiasco collo corto, sensa processo terminale.
>
> L'atrio è poco rigonfio.
>
> Nel complesso dei caratteri questa specie si avvicina alla *Br. pentodonta* . . . .
>
> Habitat: Su varie specie di *Cambarus*.
>
> Nota.—Esemplari riferibili a questa specie ho riconosciuto sovente nel materiale del Museo di Amburgo, e tutti provenieti dell'America del Nord; di questi esemplari alcuni erano registrati come viventi su *Cambarus viridis* Hay., altri su *Cambarus latimanus* Fabr., altri *Cambarus Hayi* Fosc. (Texas), altri su *Cambarus rusticus* Gir., altri su *Cambarus immunis* Hay., e su *Cambarus sp.* (Raleigh, N. Car.). È quindi da ritenere che sia una specie frequento nel Nord America.

[4] I am indebted to Mrs. Vincent Meyer, wife of the owner of Thousand Springs Ranch, for her hospitality and permission to collect on the ranch house grounds.

This description of *B. americana* could apply to several species of the branchiobdellids. The range, all provinces of North America ("e tutti provienti dall America del Nord"), can apply to no species that I know. The one clue as to the identity of the species in Pierantoni's description is in the description and illustrations of the jaws, and this could apply to several species of the genus *Cambarincola*, including the widespread *C. philadelphica*.

Among the syntypes, the only recognizable specimen belongs to *C. philadelphica* (Leidy, 1851, p. 209), conforming in all diagnostic characters to the topotypical material (Hoffman, 1963, p. 342) that is in my collection (PCH 695). *Branchiobdella americana* Pierantoni is reduced hereby to synonomy as *Cambarincola philadelphica* (Leidy) and Pierantoni's specimen "V 2914" has been labeled as the lectotype of *B. americana* and returned to the Hamburg Museum.

Branchiobdella tetradonta Pierantoni

Branchiobdella tetradonta Pierantoni 1906, p. 3; 1912, p. 12.—Ellis 1912, p. 190.—Goodnight 1940, p. 28.

Pierantoni (1906, p. 3) treats this species as follows:

Questa nuova specie è molto affine alla *Br. pentadonta* di Whitman, di cui mi sono estesamente occupato nel mio citato lavoro. . . . Gli esemplari studiati furono rinvenuti su *Astacus klamathensis* (del fiume Klamath) di California, faciente parte delle collezione del Museo di Vienna.

Caratteri esterni.—Ha forma sottile ed allungata, quasi cilindrica, con capo oviodale, provvisto di due labra, l'uno dorsale, l'altro ventrale.

È anche questa una piccola specie, non oltrepassando i 2 mm. di lunghezza e avendo una grossezza di non oltre 1/5 di mm. La ventosa posterior non è molto slargata, ed ha la forma di una piccola coppa. I pori genitali sono poco visibili. Il clitello occupa il 7° segmento dopa il capo.

Caratteri interni.—Le du mascelle (Fig. 8) sono provviste ciascuna di quattro dentelli uguali, e sono esattamenete simili fra loro.

La spermateca è fatta ad ampolla, con breve condotto di uscita.

Lo spermascecco è molto evidente; l'atrio è slargato sacciforme; il pene provvisto di rigonfiamento a forma di bulbo, e sprovvisto, come in tutte le piccole specie, di uncinetti e di guaina chitinosa.

Gli ovari sono bene sviluppati, e grosse le uova che ricolmano la cavità del 7° segmento postcefalico.

Diagnosi riassuntiva.—Corpo allungato, capo poco rigonfio, bocca provvista di due labra. Mascelle simili e provvista di quattro dentelli uguali ciascuna. Spermateca in forma di ampolla, atrio sacciforme.

Dimensioni: Lunghezza 2 mm. grossezza 1/5 mm.

Habitat: Astacus klamathensis: fiume Klamath (California).

This is all that has been recorded concerning *B. tetradonta*. Pierantoni (1912, p. 12), Ellis (1912, p. 190), and Goodnight (1940, p. 28) do no more than cite the original description with no indication that any additional material other than that on which Pierantoni based his description had been seen.

Dr. Robert P. Higgins of Wake Forest College unsuccessfully attempted to locate the types of *B. tetradonta* in the Naturhistorisches Museum, Vienna, for me. They apparently are lost and, without them, it is impossible to identify this species. I am grateful to Dr. Higgins. In the summer of 1964, my wife and I took two collections (PCH 1815, 1816; USNM 35698, 35699) from the Klamath River, one about four miles east of the village of Klamath River and the other at Burbell Resort about 10 miles north of Yreka, and a third (PCH 1817; USNM 35697) from the Shasta River about eight miles north of Yreka, all in Shasta County, Calif. Previous attempts in 1960 to collect branchiobdellids near the mouth of the Klamath in California and from just below and around the shores of Klamath Lake in Oregon were unsuccessful. All of the hundreds of specimens obtained near Yreka and the village of Klamath River belong to *Xironogiton oregonensis* Ellis, 1919; moreover, Pierantoni's (1906) illustration of the jaws of *B. tetradonta* (his fig. 8) could be one of the jaws of *X. oregonensis*. Uncertainty is introduced, however, by his statements about size (*X. oregonensis* normally exceeds 2 mm in length), shape (the species of *Xironogiton* are flattened), and the penis with hooks and a chitinous sheath. In addition, his not-too-clear drawing (his fig. 7) shows male reproductive organs more like those of *Cambarincola*, which does not have a chitinous sheath (I know of no branchiobdellid that does) nor penial hooks (which are present in at least one as yet undescribed species of the recently established genus *Oedipodrilus* Holt, 1967, and in some European species of *Branchiobdella*). It is possible that Pierantoni was dealing with small, extended, and macerated specimens of *Xironogiton oregonensis;* it is also possible that he was working with a collection containing specimens of *Cambarincola* or *Oedipodrilus:* species of both genera occur in the Coastal Range of Oregon, but not, as far as I know, in the Klamath River in California. There is grave doubt as to the type-locality. The Klamath River is a large stream of some length in Oregon and California, and it is now well known that not all parts of the same stream contain the same branchiobdellids (Hobbs, Holt, and Walton, 1967). Before I was aware of the existence of the very small village of Klamath River, I first read "fiume Klamath" to mean simply the river. This is still the reasonable interpretation, but it is possible that translation of the original locality data made the name of the fishing camp into that of the river. It is, finally, possible that Pierantoni's material was labelled incorrectly. Unless the original material is found (an unlikely event), restudied, and a lectotype designated, the status of *Branchiobdella tetradonta* must remain forever uncertain and the name regarded as a nomen inquirendum. I regard it as such.

To summarize: *Stephanodrilus obscurus* Goodnight, 1940, is designated the type of a new genus, *Magmatodrilus; Branchiobdella tetradonta* Pierantoni, 1906, unidentifiable and the types unavailable is hence regarded as a nomen inquirendum; *Branchiobdella americana* Pierantoni, 1912, is reduced to synonomy with *Cambarincola philadelphica* (Leidy, 1851). Many thousands of specimens of branchiobdellids from all parts of North America have been examined, none belong to the genus *Branchiobdella*, and the conclusion is reached that no species of this genus is endemic to North America. There are, then, no known cases of intercontinental generic ranges among the branchiobdellids.

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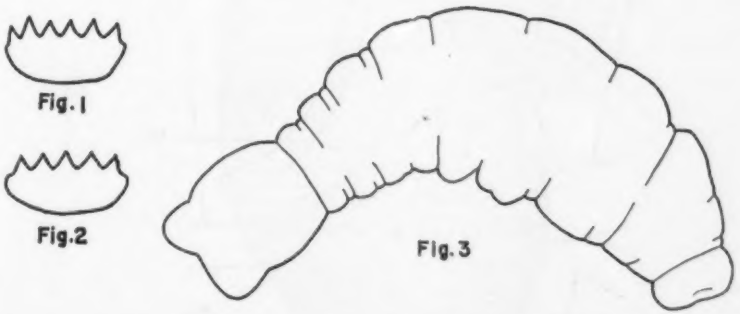

FIGURES 1–3.—*Magmatodrilus obscurus:* 1, upper jaw; 2, lower jaw; 3, body in lateral aspect.

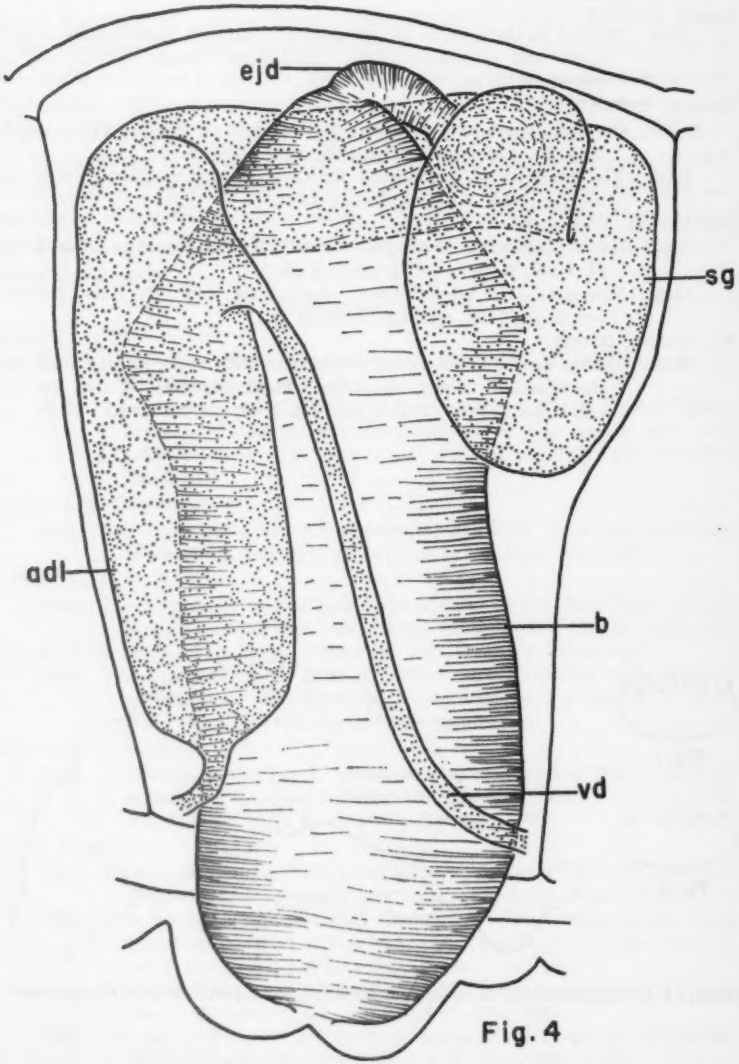

FIGURE 4.—*Magmatodrilus obscurus*, lateral view of male reproductive system (adl=anterior deferent lobe, b=bursa, ejd=ejaculatory duct, sg=spermiducal gland, vd=vas deferens).

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dl=an-
d=vas